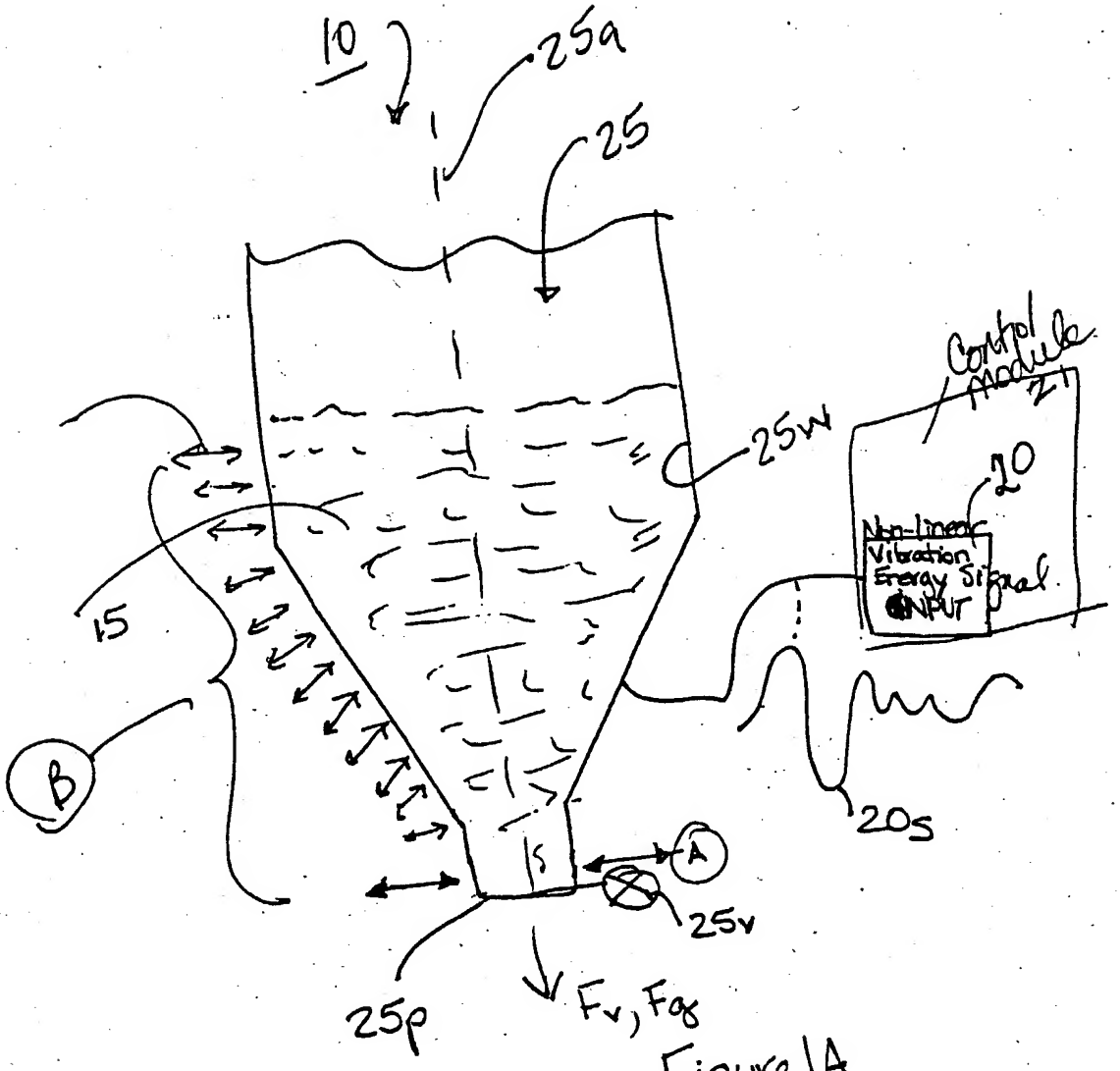

10
25a
25
Control Module
21
25w
20
Non-linear
Vibration
Energy Signal
INPUT
15
B
20s
A
25v
25p
F_v, F_g

Figure 1A

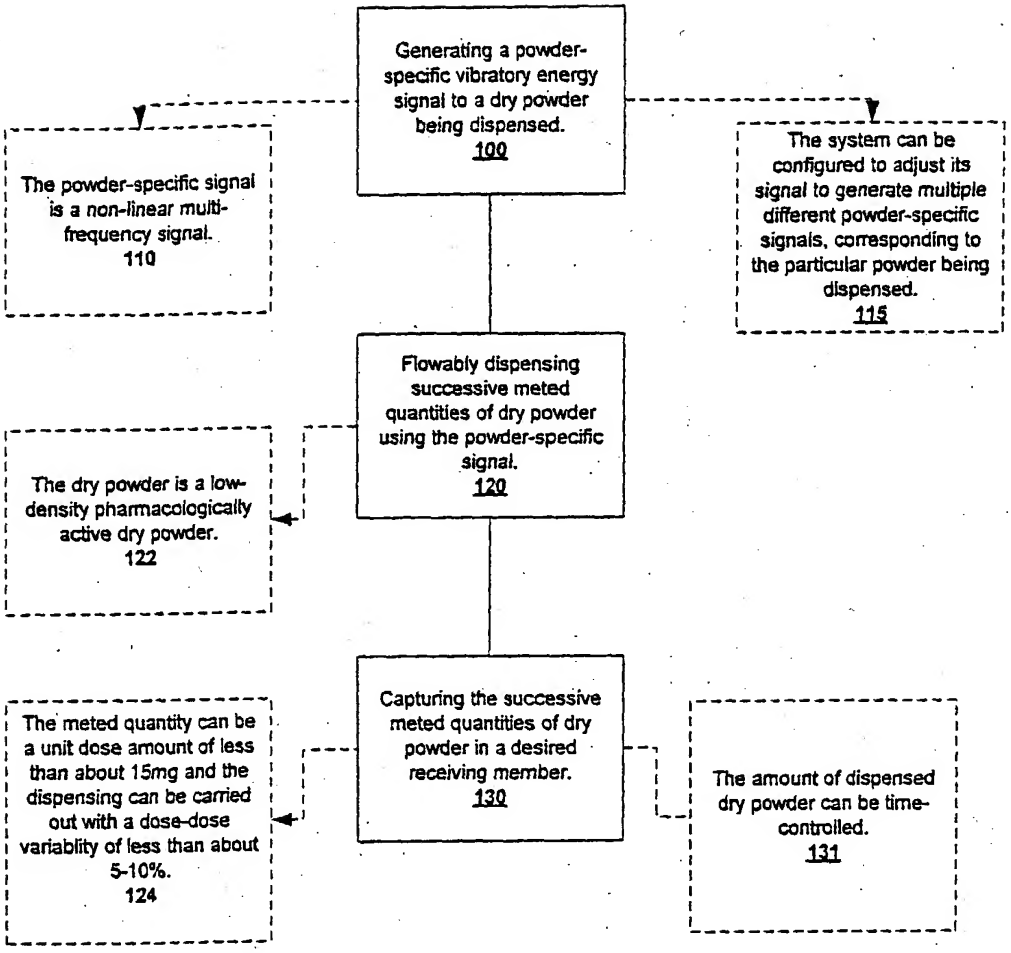

Generating a powder-specific vibratory energy signal to a dry powder being dispensed.
100
The powder-specific signal is a non-linear multi-frequency signal.
110
The system can be configured to adjust its signal to generate multiple different powder-specific signals, corresponding to the particular powder being dispensed.
115
Flowably dispensing successive meted quantities of dry powder using the powder-specific signal.
120
The dry powder is a low-density pharmacologically active dry powder.
122
Capturing the successive meted quantities of dry powder in a desired receiving member.
130
The meted quantity can be a unit dose amount of less than about 15mg and the dispensing can be carried out with a dose-dose variablity of less than about 5-10%.
124
The amount of dispensed dry powder can be time-controlled.
131

FIGURE 1B

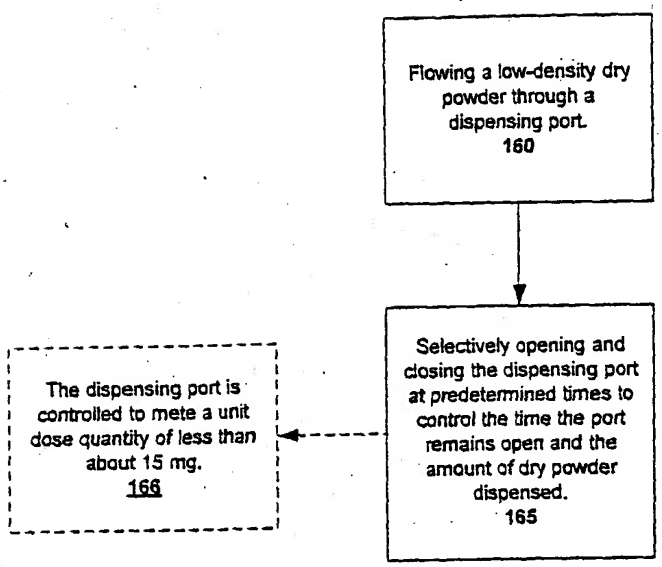
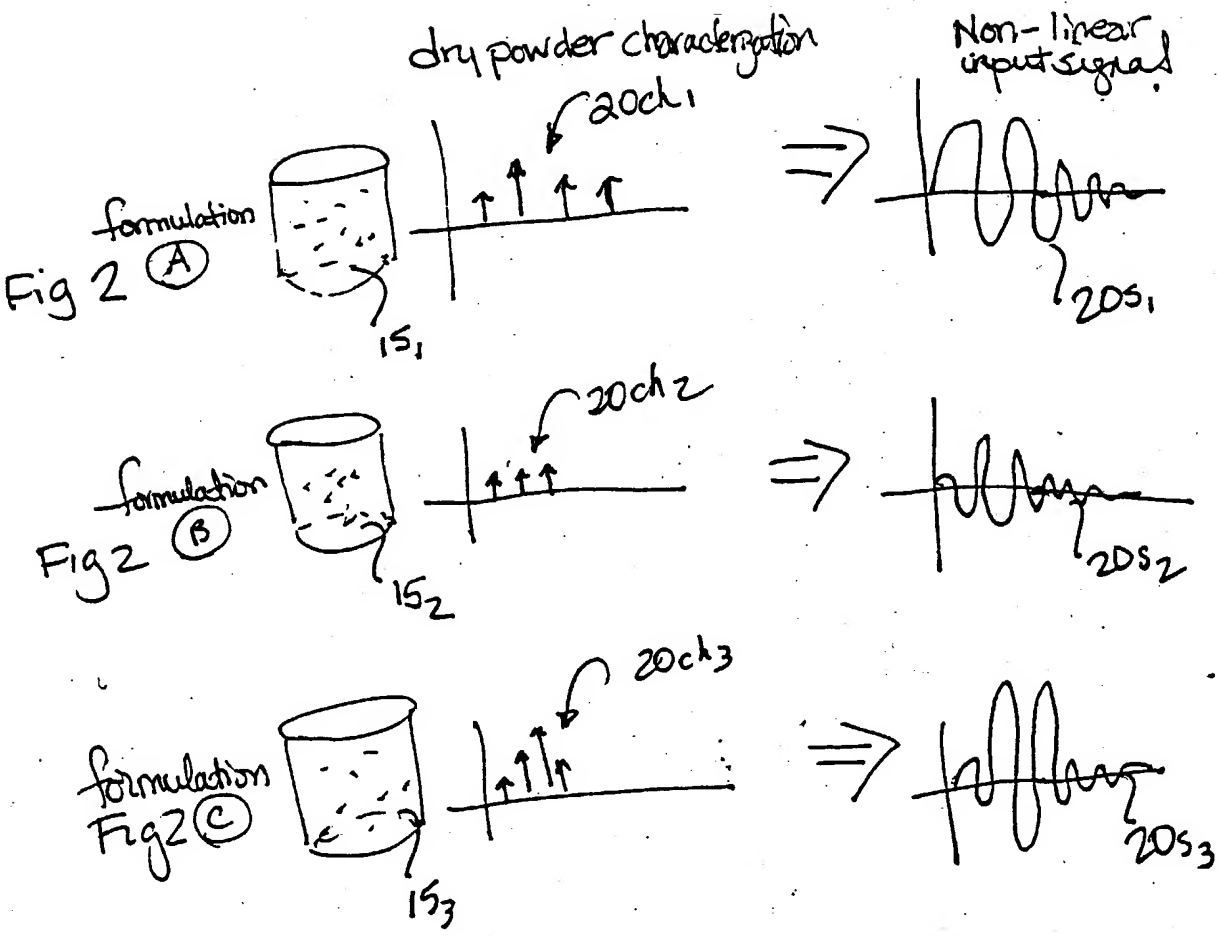

Flowing a low-density dry powder through a dispensing port.
160
Selectively opening and closing the dispensing port at predetermined times to control the time the port remains open and the amount of dry powder dispensed.
165
The dispensing port is controlled to mete a unit dose quantity of less than about 15 mg.
166

FIGURE 1C


dry powder characterization
Non-linear input signal
20ch1
formulation
Fig 2 (A)
15₁
20S₁
20ch2
formulation
Fig2 (B)
15₂
20S₂
20ch3
formulation
Fig2 (C)
15₃
20S₃

SIGNAL GENERATION ALGORITHM

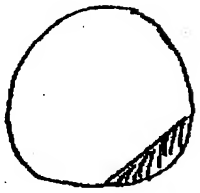


Fig. 3A

Measure time between avalanches for powders in Rotating drum

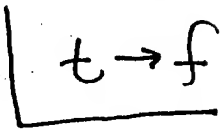


Fig. 3B

convert time to frequency space

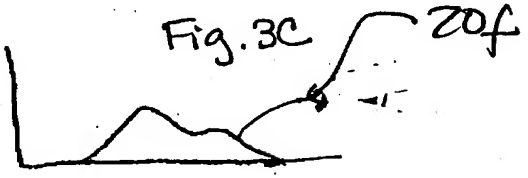


Fig. 3C

plot distribution of frequencies

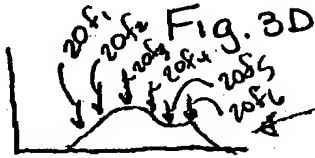


Fig. 3D

Record top six most observed frequencies, typically representing 75% of distribution

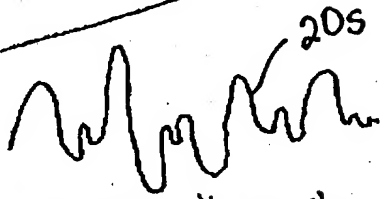
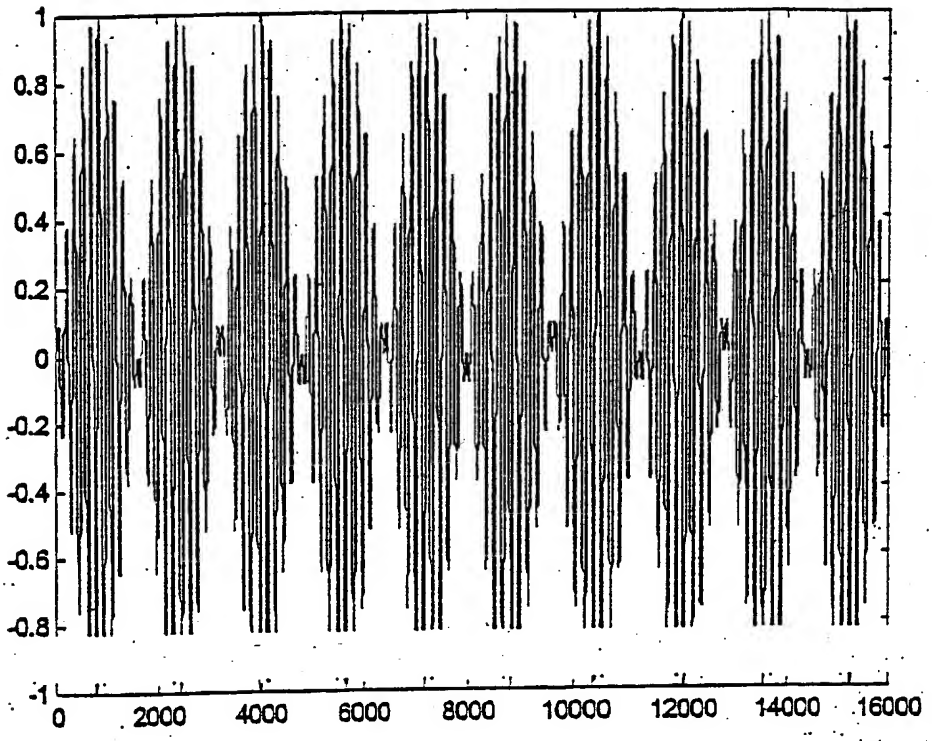


Fig. 3E

Superimpose these six frequencies to construct a single superposition signal (can include step of adjusting relative amplitudes)

FIGURE 14


1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
2000
4000
6000
8000
10000
12000
14000
16000

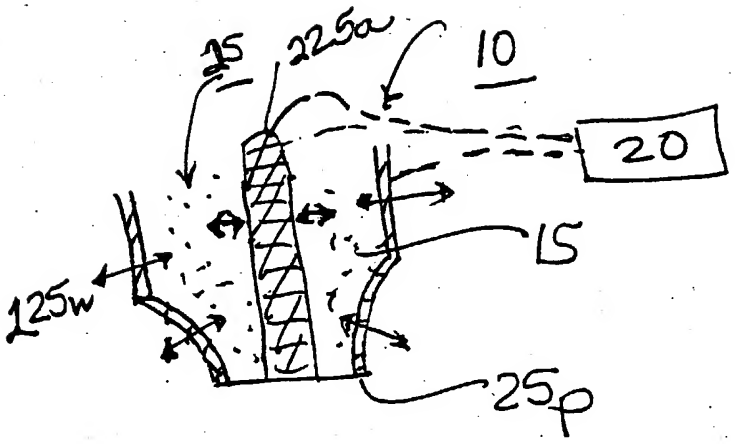

25
225a
10
20
15
125w
25p

Fig. 5A

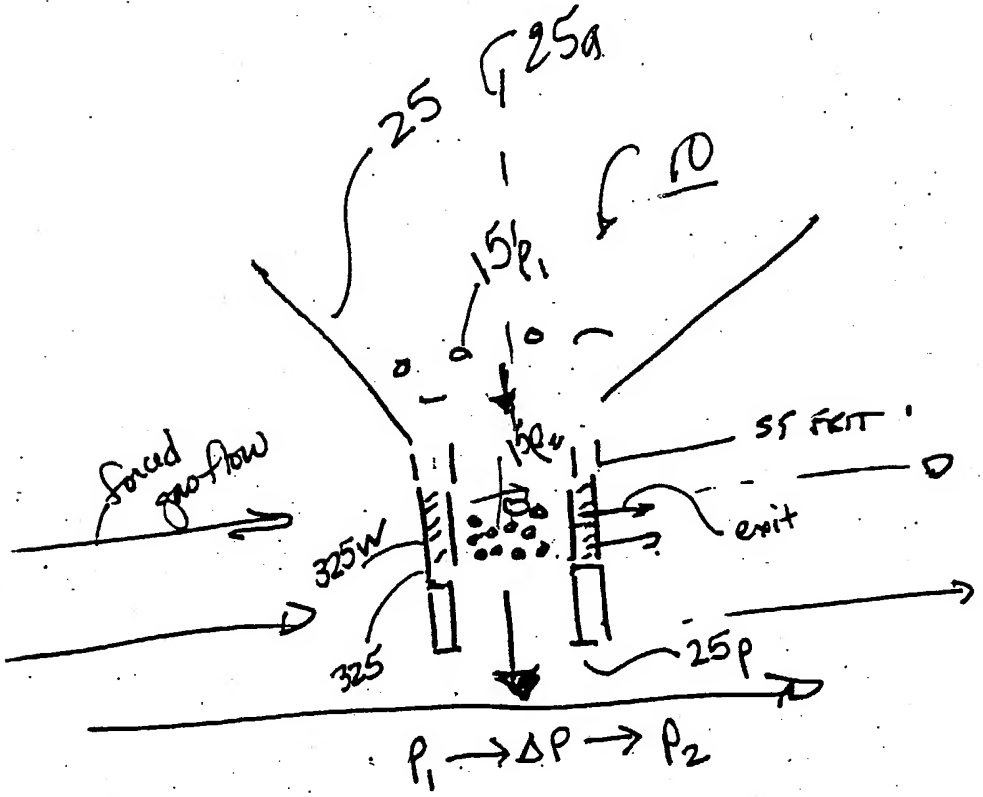

25a
25
10
15p1
forced gas flow
325w
exit
325
25p
P1 → ΔP → P2

Fig. 5B

NON-LINEAR. VIBRATION / CENTRIFUGATION PRINCIPLE OF POWDER FILLING.

Basic Principle:

Combine non-linear function with centrifugal motion

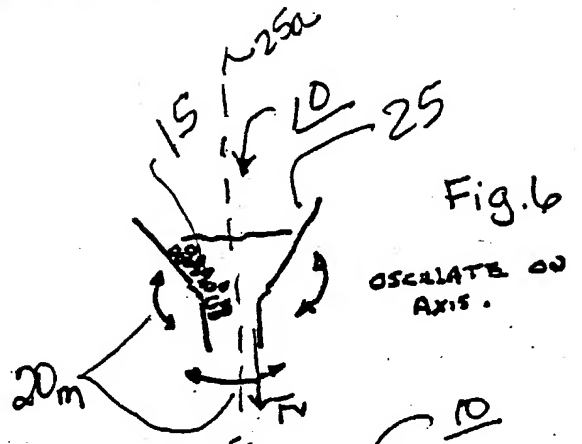


Fig.6

This can be adapted to local non-linear vibration.

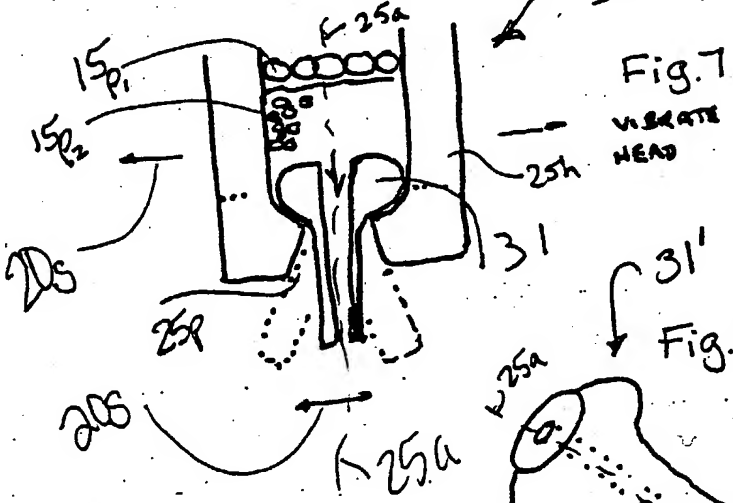


Fig.7

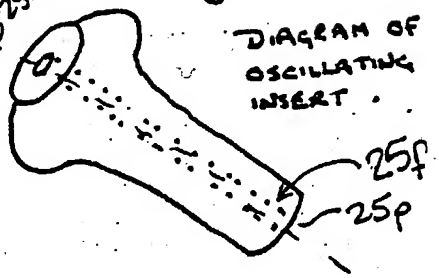


Fig.8

Vibration can be applied to a rack of heads filling from single hopper.

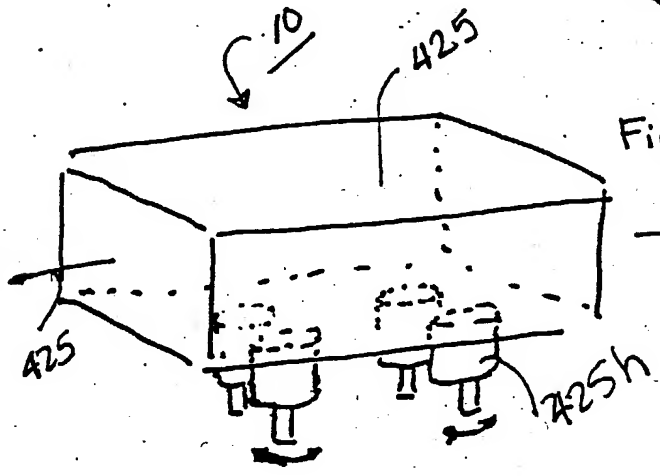


Fig.9

Radius (or extremes) of motion can be very small. At high frequency the angular velocity will be sufficient to give directional acceleration to particles.

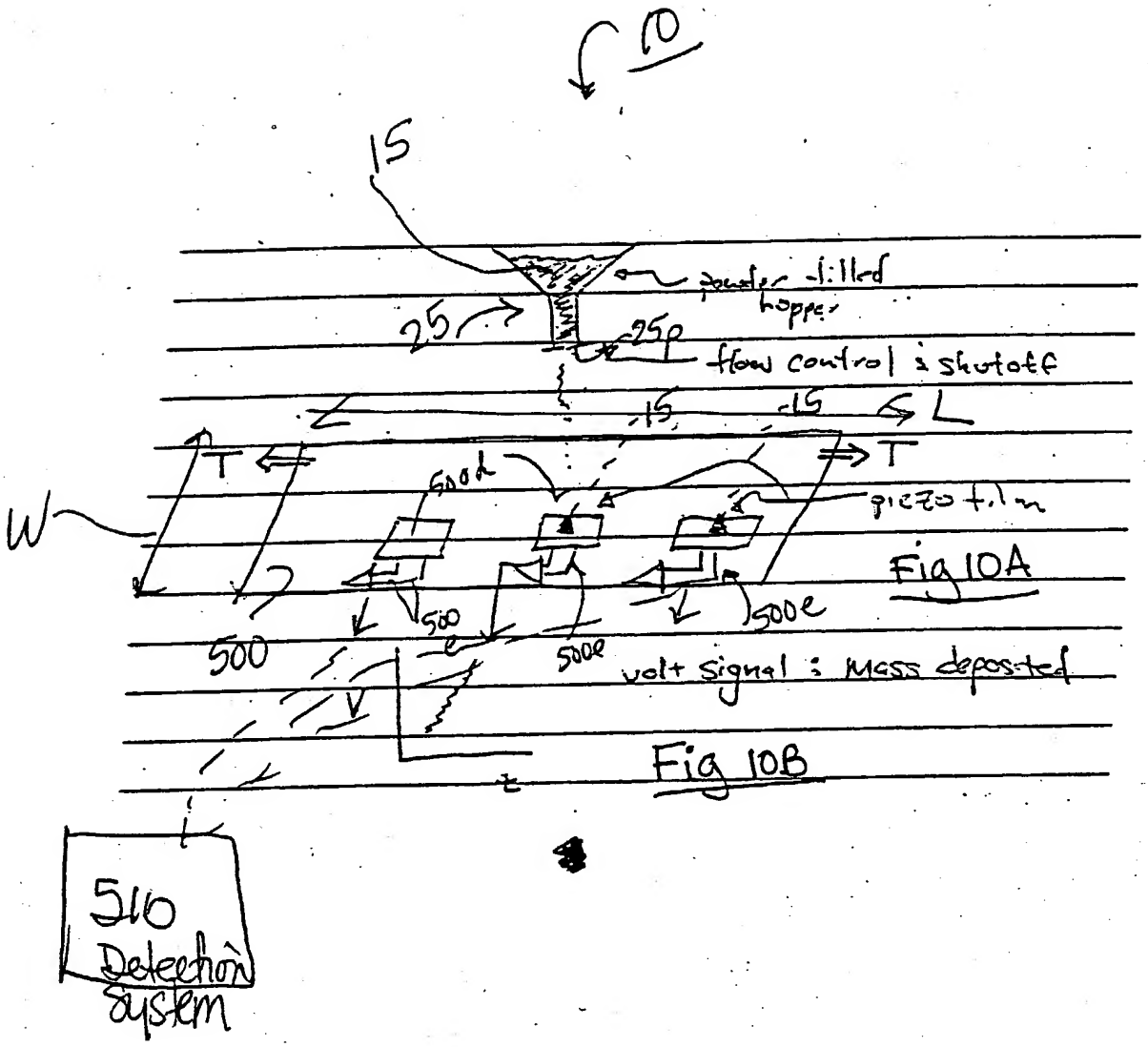


Fig 10A

Fig 10B

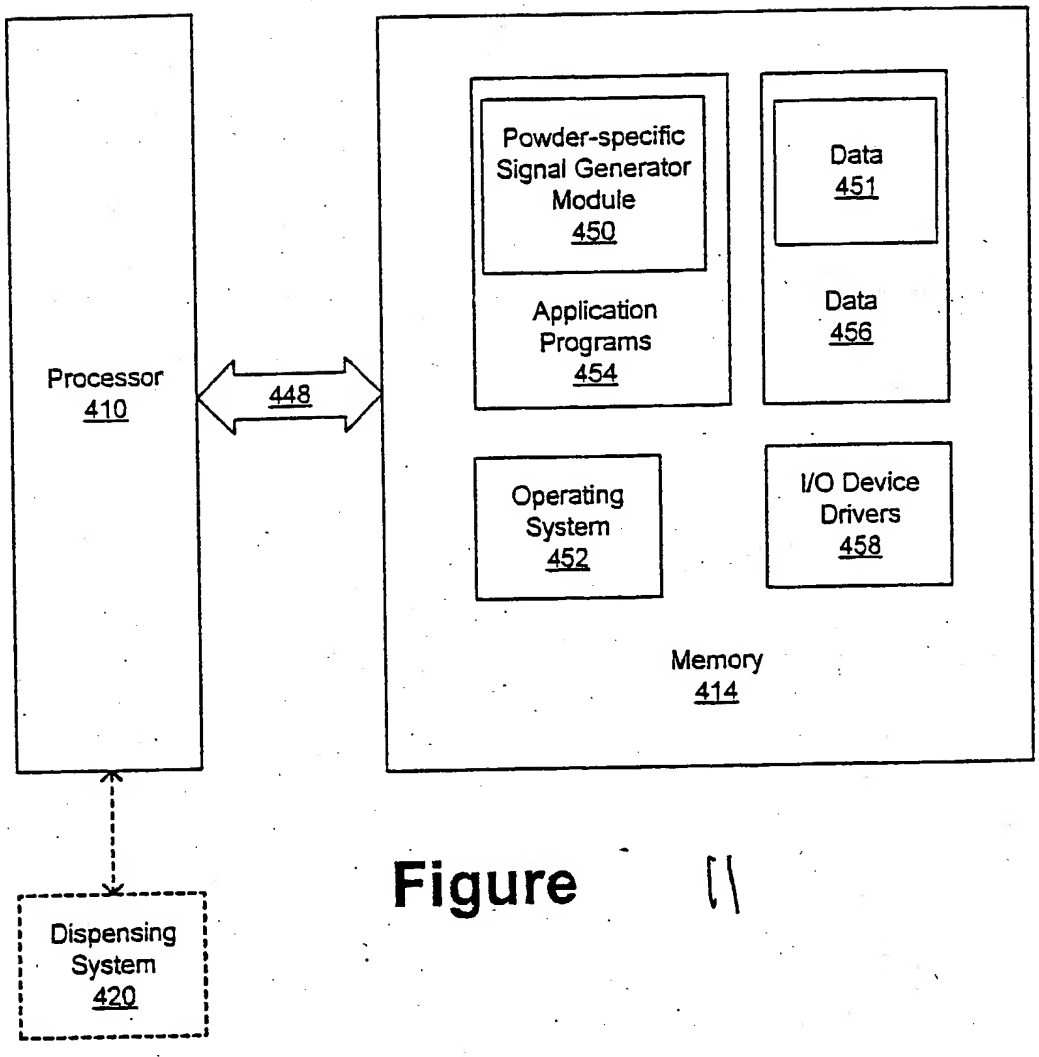

Processor
410
448
Powder-specific
Signal Generator
Module
450
Application
Programs
454
Data
451
Data
456
Operating
System
452
I/O Device
Drivers
458
Memory
414
Dispensing
System
420

Figure 11

FIGURE 12

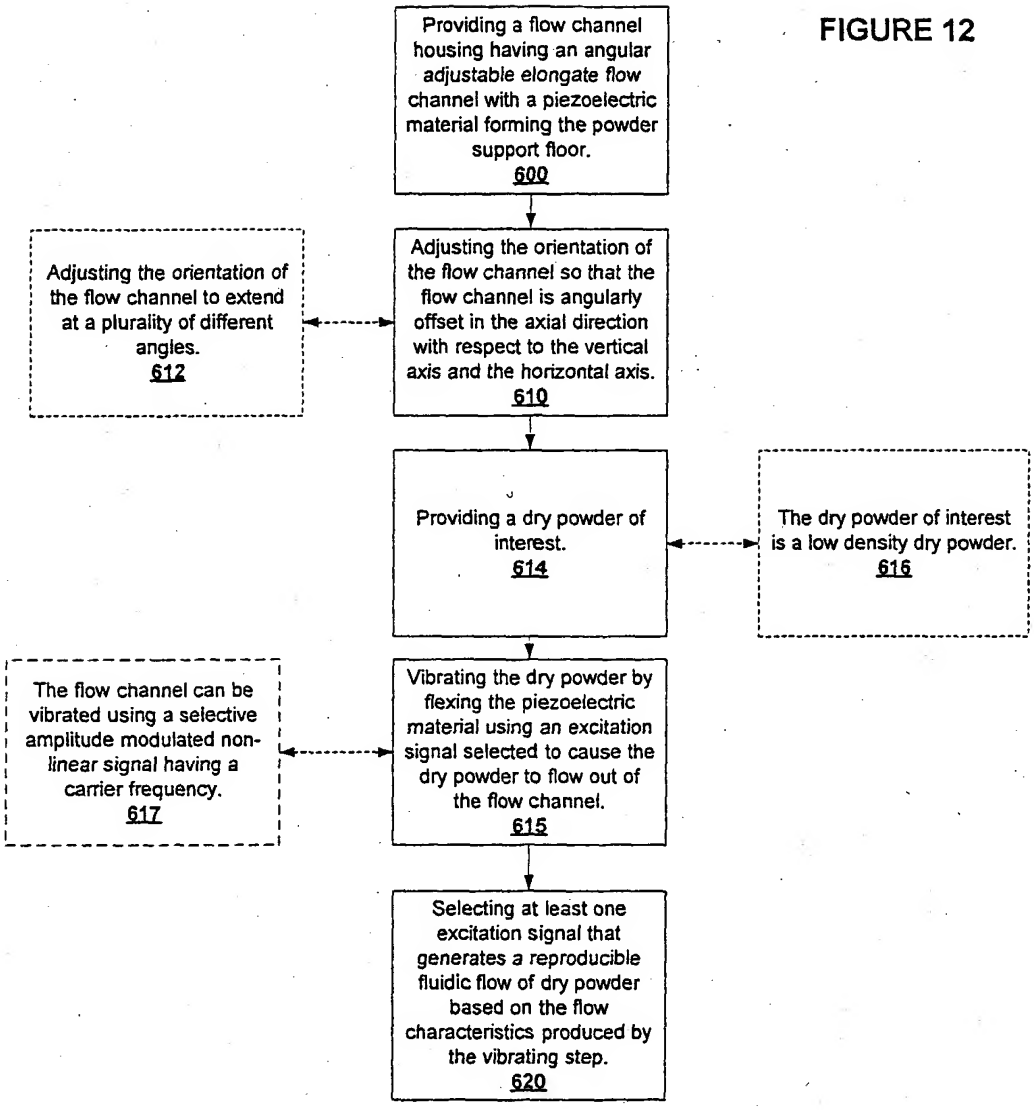
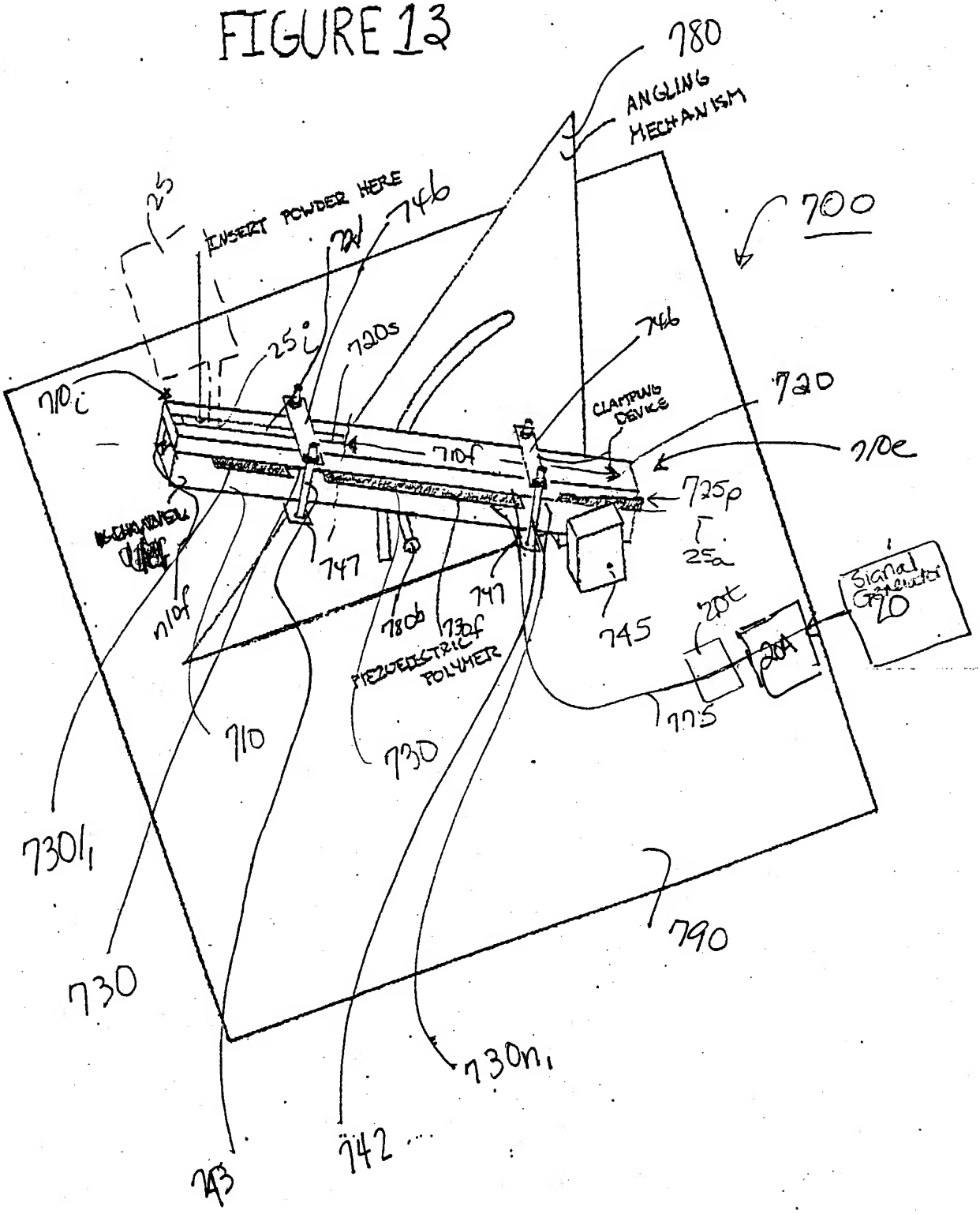
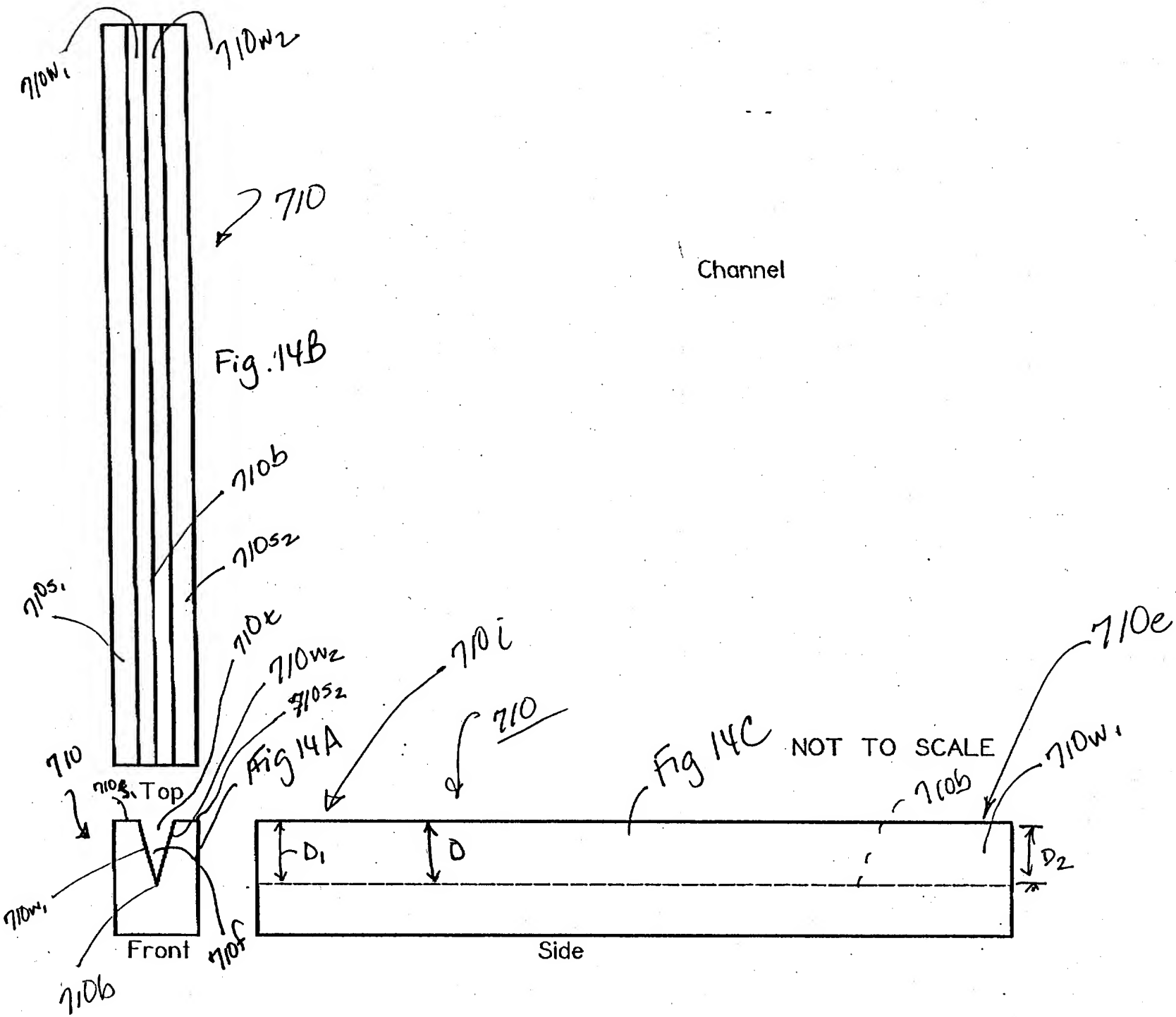

Providing a flow channel housing having an angular adjustable elongate flow channel with a piezoelectric material forming the powder support floor.
600
Adjusting the orientation of the flow channel so that the flow channel is angularly offset in the axial direction with respect to the vertical axis and the horizontal axis.
610
Adjusting the orientation of the flow channel to extend at a plurality of different angles.
612
Providing a dry powder of interest.
614
The dry powder of interest is a low density dry powder.
616
Vibrating the dry powder by flexing the piezoelectric material using an excitation signal selected to cause the dry powder to flow out of the flow channel.
615
The flow channel can be vibrated using a selective amplitude modulated non-linear signal having a carrier frequency.
617
Selecting at least one excitation signal that generates a reproducible fluidic flow of dry powder based on the flow characteristics produced by the vibrating step.
620

FIGURE 13


780
ANGLING MECHANISM
700
INSERT POWDER HERE
25
24
746
25i
720s
710i
710f
720
CLAMPING DEVICE
710e
725p
25a
747
745
20t
20
Signal Generator
775
710
730
780b
730f
PIEZOELECTRIC POLYMER
730n
790
742
743


710W1
710W2
710
Channel
Fig. 14B
710b
710s2
710s1
710c
710W2
710s2
710
Fig 14A
710s1 Top
710W1
Front
710f
710b
710i
710
Fig 14C
NOT TO SCALE
710e
710b
710W1
D1
D
D2
Side

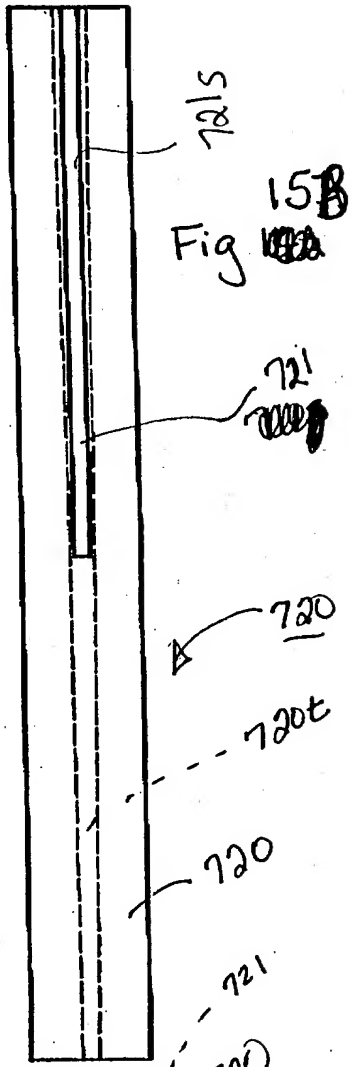


Fig 15B

Fig 15A

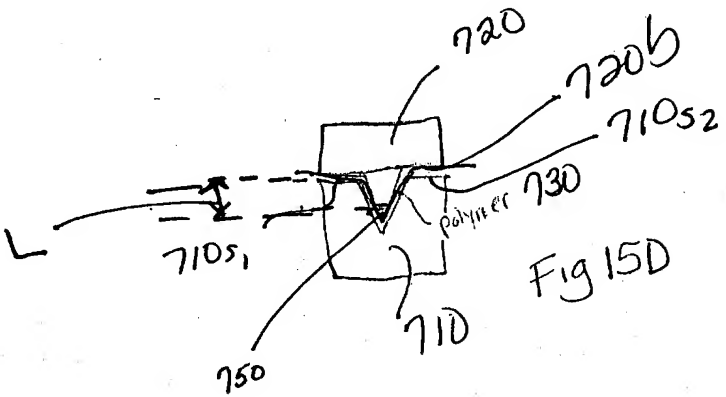


Fig 15D

NOT TO SCALE

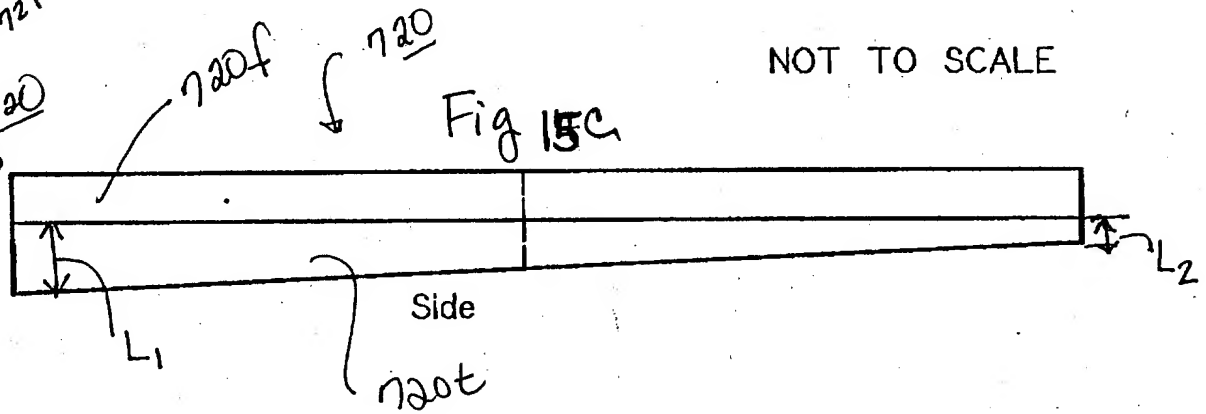


Fig 15C

Part 3: Piezoelectric Polymer
NOT TO SCALE

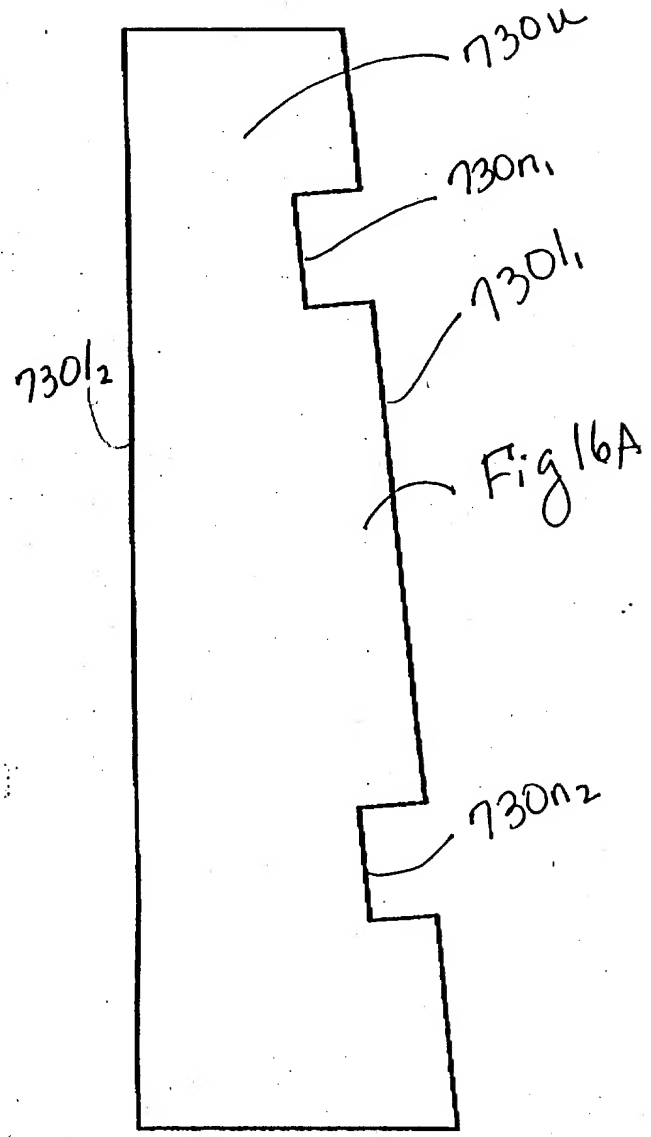


Fig 16A

NOT TO SCALE

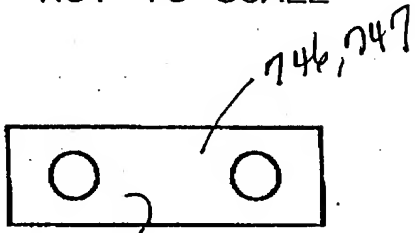


Fig 16B

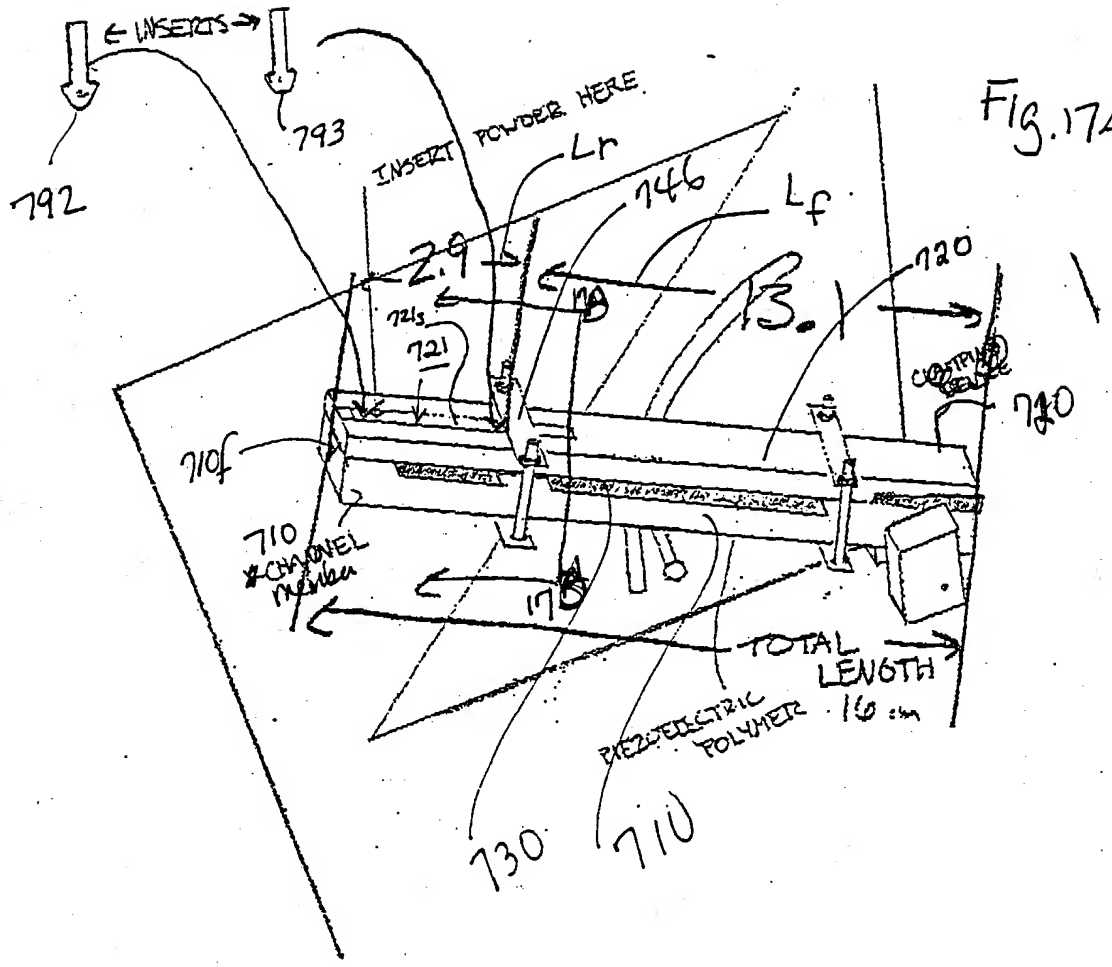


Fig. 17A

Fig. 17B